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PATENT

UTILITY CERTIFICATE

Intellectual Property Code - Book VI

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REQUEST FOR GRANT

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| SUBMISSION OF DOCUMENTS DATE 15 JAN. 2003 PLACE 75 INPI PARIS NATIONAL REGISTRATION No. 03/00,381 ASSIGNED BY THE INPI DATE OF FILING ASSIGNED BY THE INPI 15 JAN. 2003 | | 1 NAME AND ADDRESS OF THE APPLICANT OR THE REPRESENTATIVE TO WHOM THE CORRESPONDENCE IS TO BE ADDRESSED Georges BOURGEOIS SAINT-GOBAIN RECHERCHE 39 QUAI LUCIEN LEFRANC 93300 AUBERVILLIERS | |
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| 3 TITLE OF THE INVENTION (200 characters or spaces maximum) BACKPROJECTION AND/OR PROJECTION SCREEN | | | |
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BACKPROJECTION and/or PROJECTION SCREEN

The present invention relates to a backprojection and/or projection screen. It relates more particularly
5 to a screen suitable for allowing an image to be displayed without any defect on both faces of the screen, this image possibly coming, for example, from a video projector or more generally from a light source positioned so as to face one of the faces of the
10 screen.

For the sake of understanding, the projection screen according to the invention has two faces, namely the main face of the screen on which the image coming from
15 the light source is projected, which main face is generally positioned in the same region in space as the light source, and the opposite face of the screen on which the image projected on the main face appears when viewed in transmission. A backprojection screen has a
20 main face and an opposite face possessing the same characteristics as the abovementioned projection screen but is distinguished therefrom by the fact that the user and the light source are not located in the same region in space but are on either side of the screen.

25 For the purposes of the present invention, the term "screen" will be used to encompass both a projection screen and a backprojection screen.

30 Several types of backprojection screen families for displaying such an image are known. Thus, plastic screens or diffusers are known, these rigid and translucent screens having a plastic matrix constituting the framework of the screen into which a
35 plurality of metal oxide (for example SiO_2) particles are incorporated. These screens allow an image to be correctly viewed without any optical defect at a

lower optical quality (presence of blurring). In addition, plastic backprojection screens are sensitive to ultraviolet and infrared radiation and to moisture, thereby limiting their lifetime and the perpetuity of
5 their optical quality.

Also known are screens that can be unwound from a reel fastened to a support. They are also made of plastic, but are not translucent. They operate only in
10 reflection and not in transmission.

Another screen technology was developed from diffusers that operate using the technology of liquid crystals. The main advantage of this type of screen lies, on the
15 one hand, in their small thickness (of around 20 μm) and, on the other hand, most particularly, in the fact that, under the action of an electric field, they become transparent and no longer diffusing, their use in backprojection being however only a secondary use.

20 However, as drawbacks, the viewing angle is very limited (the viewing angle is around thirty degrees or so) and the image that appears on the opposite face is of poor optical quality, despite the small thickness of
25 the screen (presence of blurring).

Document US 5 870 224 discloses a structure of projection screen provided, on the one hand, on its main face, with a plurality of optical devices
30 (cylindrical microlenses and Fresnel lenses) and, on the other hand, on its opposite face, a plurality of orifices (transparent and slightly diffusing regions) that are judiciously positioned relative to the respective optical foci of the said cylindrical lenses,
35 allowing the projected image to be displayed.

This screen structure is particularly expensive, the viewing angle is also small (about 35°) and this device is not conducive to direct projection (view in reflection).

5

Finally, a last backprojection screen family consists of holographic diffusers.

10 The main advantage of this technology lies in the transparency of the screen and the adjustment of the viewing angle. However, here again, this screen structure is expensive, thereby confining it to small-format screens. The presence of blurring on the opposite face of the screen is also noted, despite the
15 transparency of the screen.

The aim of the present invention is therefore to alleviate the drawbacks of the devices known from the prior art by providing a backprojection and/or
20 projection screen suitable for displaying an image on both faces of the screen at a viewing angle possibly up to 180° on both faces, this display being effected without any optical defects on both faces, that is to say with excellent uniformity of the displayed image.

25

For this purpose, the backprojection and/or projection screen according to the invention is characterized in that it comprises at least a first substrate joined to a scattering layer producing a subsurface effect, said
30 layer being suitable for obtaining a viewing angle of less than or equal to 180° on both faces of the said layer.

To gain a better understanding of the invention, the
35 word "subsurface" will be defined below. A layer is said to be subsurface when its thickness varies within the 0.5 to 50 µm range, especially the range between

0.5 and 10 μm and preferably between 0.5 and 5 μm . This definition is to be compared with a scattering layer producing a volume effect.

5 In the preferred embodiments of the invention, one or more of the following provisions may optionally also apply:

- the resolution of the screen is at least 10^5 dpi;
- 10 - the scattering layer is deposited on one of the faces of the first substrate and a lamination interlayer is deposited on the opposite face of the said first substrate, the said interlayer in turn being joined to a second substrate;
- 15 - the second substrate is a tinted substrate;
- the scattering layer is deposited on one of the faces of a first substrate, the said first substrate being in turn joined to a second substrate so as to form a double-glazing unit;
- 20 - the first substrate and the scattering layer are joined to a third substrate, a peripheral bead separating that face of the first substrate which is coated with the said scattering layer from the third substrate;
- 25 - the scattering layer consists of elements comprising particles and a binder, the binder allowing the particles to be mutually agglomerated;
- the particles are metal or metal oxide particles;
- 30 - the particles are chosen from silica, alumina, zirconia, titanium and cerium oxides, or a mixture of at least two of these oxides;
- the particle size is between 50 nm and 1 μm ;
- the thickness of the scattering layer is
35 between 0.5 and 5 μm ;
- at least one of the first, second and third substrates is a glass substrate;

- at least one of the first, second and third substrates is a transparent substrate based on a polymer, for example polycarbonate; and

5 - at least one of the first, second and third substrates includes a coating having another functionality, especially a coating with a low-emissivity function or an antistatic, antimisting, antifouling or antireflection function.

10 Other advantages and features of the invention will become apparent in the light of the detailed description that follows.

Thus, according to one embodiment of the invention, the
15 scattering layer producing a subsurface effect consists of particles agglomerated in a binder, the said particles having a mean diameter of between 0.3 and 2 microns, the said binder being in a proportion of between 10 and 40% by volume and the particles forming
20 aggregates whose size is between 0.5 and 5 microns, the said layer having a contrast attenuation of greater than 40% and preferably greater than 50%. This scattering layer is described in Application WO 01/90787 and the contents of that application are
25 incorporated in the present application for reference.

The particles are chosen from semitransparent particles and preferably from mineral particles such as oxide, nitride and carbide particles.

30

The particles will preferably be chosen from silica, alumina, zirconia, titanium and cerium oxides, or from a mixture of at least two of these oxides.

35 Such particles may be obtained by any means known to those skilled in the art and especially by precipitation or by pyrolysis. The particle size is

such that at least 50% of the particles depart from the mean diameter by less than 50%.

When the layer is in an external position, the binder is also chosen to have an abrasion resistance sufficient for the backprojection system to be handled without any damage, for example in particular with the other substrates forming the screen are being mounted.

Depending on the requirements, the binder may be chosen to be a mineral binder, for example in order to increase the temperature resistance of the layer, or an organic binder, especially so as to make it simpler to produce the said layer, it being possible for crosslinking to take place simply, for example room-temperature crosslinking.

The binder has a different index from that of the particles and the difference between these two indices is preferably at least 0.1. The index of the particles is greater than 1.7 and that of the binder is preferably less than 1.6.

The binder is chosen from potassium silicates, sodium silicates, lithium silicates, aluminium phosphates, polymers of the polyvinyl alcohol type, thermosetting resins, acrylics, etc.

To promote the formation of aggregates of the desired size, at least one additive resulting in a random distribution of the particles within the binder may be added. The dispersion additive or dispersant is chosen from the following agents: an acid, a base or ionic polymers of low molecular mass, especially less than 50 000 g/mol.

It is also possible to add other agents and, for example, a wetting agent such as nonionic , anionic or cationic surfactants in order to provide a layer that is homogeneous on a large scale.

5

It is also possible to add rheology modifiers, such as cellulose ethers.

10 The layer thus defined may be deposited with a thickness of between 1 and 20 microns. The methods of depositing such a layer may be any of those known to those skilled in the art, such as deposition by screen printing, by paint coating, by dip coating, by spin coating, by flow coating, by spraying etc.

15

When the desired thickness of the deposited layer is greater than 2 microns, a deposition process of the screen-printing type is used.

20 As a variant - a preferred embodiment - of a binder used in a screen-printing deposition process, a binder essentially consisting of a glass frit or flux is used. This glass frit or flux may, for example, be based on a mixture of zinc oxide, boron oxide, silica and sodium
25 oxide.

This binder is applied in the present invention as binder for the scattering layer used in the backprojection and/or projection screen, but it may
30 also be used as binder in a scattering layer integrated into a screen, for example a diffusion screen.

When the thickness of the layer is less than 4 microns, it is preferably deposited by flow coating or by
35 spraying.

It is also possible to produce a layer whose thickness varies depending on the area of coverage on the surface; such an embodiment makes it possible to correct intrinsic inhomogeneties of a light source restored on the screen. For example, it is possible in this way to correct the intensity of light sources according to the viewer's viewing angle and thus to adjust the gain. The gain is defined in the following manner:

10

gain - luminance obtained with the screen viewed centrally/luminance obtained with a Lambertian screen with a gain of 1, viewed centrally.

15 Thus, the gain may also be defined in the following manner:

gain = central luminance x area of the screen / flux of the projector.

20 From these definitions, the projection screen is said to have a gain of 1 when it allows a 180° viewing angle (Lambertian screen).

25 In addition, if the screen allows the light rays to be reoriented in a more restricted viewing angle, thus increasing the luminance of the image within these angles, the screen will then have a gain of greater than 1.

30 According to another embodiment, selective deposition of the subsurface layer may be envisaged, and in this case it will be deposited only over part of the substrate, the transparent remaining part.

35 According to the invention, the scattering layer is deposited on a first transparent substrate, which may

According to the invention, the scattering layer is deposited on a first transparent substrate, which may or may not have a flat shape depending on the application.

5

The scattering layer producing a subsurface effect makes it possible to produce a screen whose resolution is at least 10^5 dpi (dots per inch) or 10^6 dpi.

10 To improve mechanical integrity of the first substrate coated with the scattering layer producing a subsurface effect, as described above, a lamination interlayer is joined to the first substrate on its opposed face (that face not covered with the scattering layer), it being
15 possible for this interlayer to be made of PVB (polyvinyl butyral) or PU (polyurethane), for example, and in turn to be joined to a second, preferably tinted, substrate. As a non-limiting example, this may, for example, be a glass allowing the contrast to be
20 improved, such as a grey glass with a TL of 10%.

A third substrate is joined to this laminated element consisting of the first substrate, the lamination interlayer and the second substrate.

25

A sealing bead, made of plastic (for example PU or EPDM) is deposited by known means (for example extrusion) around the periphery of that face of the first substrate which includes its scattering layer. A
30 third substrate is deposited on this sealing bead. This bead of material provides the assembly with mechanical integrity and maintains a cavity filled with a gaseous fluid (especially air) between the two substrates, thereby enhancing the scattering phenomena within the
35 scattering functional layer.

substrates or polymer (PMMA or polycarbonate) substrates.

5 Whatever the embodiment, the backprojection and/or projection screen according to the invention allows an image to be restored with a uniformity of at least 80% and preferably around 85%.

10 An image is said to be uniform when observation made by eye of this image on a screen having the dimensions of 600x450 mm shows no variation in intensity of the image owing to the quality of the layer, for example. The eye starts to "see" intensity variations only when the intensity difference from one point on the screen to
15 another is greater than 15%.

The display screen is suitable for viewing an image projected on both faces of the screen, with a viewing angle of less than or equal to 180°C.
20

In the present invention, the viewing angle is the angle for which the luminance is equal to one half of the luminance at the centre. In this case, the display is formed without any optical defect (blurring, distortion, edge effect, chromatic aberration, local
25 luminance inhomogeneity on either of the faces.

An alternative embodiment consists in incorporating, into the assembly at one of the faces of one of the
30 first, second or third substrates, a coating having a functionality. This may be a coating with the function of blocking radiation of wavelengths in the infrared (for example using one or more silver layers surrounded by dielectric layers, or layers made of nitrides, such
35 as TiN or ZrN, or layers made of metal oxides or steel or an Ni-Cr alloy), or having a low-emissivity function (for example a doped metal oxide such as F:SnO₂ or tin-

doped indium oxide ITO or one or more silver layers),
an antifogging function (by means of a hydrophilic
layer), an antifouling function (photocatalytic
coating, comprising TiO_2 at least partially
5 crystallized in anatase form) or else an antireflection
multilayer, for example of the $\text{Si}_3\text{N}_4/\text{SiO}_2/\text{Si}_3\text{N}_4/\text{SiO}_2$ type.

The envisaged applications of the invention are in
particular the backprojection or projection systems
10 used, for example, for displaying an image coming, for
example, from video projectors, for the use of image
walls in stadiums, for information display panels
joined together as a wall or suspended for municipal
domestic use. Of course, the projection and/or
15 backprojection screen may be used as a partition or a
wall separating two enclosures.

The screen according to the invention described above
offers many advantages:

- 20 - because the various constituent elements are
made using an essentially mineral technology, the
sensitivity of this screen to moisture and to UV
radiation is very low; and
- the use of a scattering layer producing a
25 subsurface effect, the viewing angle of which may be up
to 180° , limits "hot spot" phenomena (By "hot spot" is
meant that the viewer can perceive, along the
projection axis and through the screen, the light
source).

CLAIMS

1. Backprojection and/or projection screen characterized in that it comprises at least a first
5 substrate joined to a scattering layer producing a subsurface effect, said layer being suitable for obtaining a viewing angle of less than or equal to 180° on both faces of the said layer.
- 10 2. Screen according to Claim 1, characterized in that the resolution of the screen is at least 10^5 dpi.
3. Screen according to either of Claims 1 and 2, characterized in that the scattering layer is deposited
15 on one of the faces of the first substrate and a lamination interlayer is deposited on the opposite face of the said first substrate, the said interlayer in turn being joined to a second substrate.
- 20 4. Screen according to Claim 3, characterized in that the second substrate is a tinted substrate.
5. Screen according to one of the preceding claims, characterized in that the first substrate and the
25 scattering layer are joined to a third substrate, a peripheral bead separating that face of the first substrate which is coated with the said scattering layer from the third substrate.
- 30 6. Screen according to one of the preceding claims, characterized in that the scattering layer consists of elements comprising particles and a binder, the binder allowing the particles to be mutually agglomerated.
- 35 7. Screen according to Claim 6, characterized in that the particles are metal or metal oxide particles.

8. Screen according to either of Claims 6 and 7, characterized in that the particles are chosen from silica, alumina, zirconia, titanium and cerium oxides, or a mixture of at least two of these oxides.

5

9. Screen according to one of Claims 6 to 8, characterized in that the particle size is between 50 nm and 1 μm .

10 10. Screen according to Claim 6, characterized in that the binder essentially consists of a glass frit or flux.

11. Screen according to Claim 10, characterized in
15 that the glass frit or flux is based on a mixture of zinc oxide, boron oxide, sodium oxide and silica.

12. Screen according to one of the preceding claims, characterized in that the thickness of the scattering
20 layer is between 0.5 and 5 μm .

13. Screen according to one of the preceding claims, characterized in that at least one of the first, second and third substrates is a glass substrate.

25

14. Screen according to one of claims 1 to 12, characterized in that at least one of the first, second and third substrates is a transparent substrate based on a polymer.

30

15. Screen according to one of the preceding claims characterized in that at least one of the first, second and third substrates includes a coating having another functionality, especially a coating with a low-
35 emissivity function or an antistatic, antimisting, antifouling or antireflection function.

**PATENT****UTILITY CERTIFICATE**

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DESIGNATION OF THE INVENTOR(S) Page No. . 1 . / . 1
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| NATIONAL REGISTRATION NO. | | 03/00,381 | |
| TITLE OF THE INVENTION (200 characters or spaces maximum) BACKPROJECTION AND/OR PROJECTION SCREEN | | | |
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